RESEARCH HIGHLIGHTS

Technical Series 99-124

RESEARCH PROJECT ON THE NOISE INSULATION PROVIDED BY EXTERIOR WALLS IN WOOD CONSTRUCTION

Introduction

At the time this research project was undertaken, the acoustical data available on exterior walls was virtually non-existent. The main objective of this project was to fill this void by investigating the sound attenuation properties of four exterior walls commonly used in Canadian low cost residential housing.

Wall Compositions Tested

A total of nine Sound Transmission Loss measurements were conducted on the four exterior walls selected: two walls with 38 mm x 140 mm (2" x 6") studs and two with 38 mm x 89 mm (2" x 4") studs. Five tests were carried out on walls with no exterior finishes and four on walls with PVC cladding. All the wall compositions selected had a thermal insulation factor of RSI 3.5 (R_{20}). To establish the effect of varying the stud spacing, one sound transmission loss test was performed on a wall whose studs were spaced 600 mm (24") apart. The rest of the specimens were constructed with studs spaced at 400 mm (16") o.c. which is presently the stud spacing most often used for exterior walls in Canadian construction. The interior finish was the same for all the walls tested: 13 mm (½") drywall.

Summary of Findings

The conclusions reached during the present study are as follows:

- Spacing the 38 mm x 140 mm (2" x 6") studs of an exterior wall at 600 mm (24") o.c. (wall n° 1) instead of 400 mm (16") o.c. (wall n° 2) resulted in an increase of 6 points of STC[1] and in an increase of 2 points of OITC[2]. The sound transmission loss values of the wall constructed with studs at 600 mm (24") o.c. are generally higher or in the same order as those of the wall constructed with studs at 400 mm (16") o.c. except for frequencies below 80 Hz for which the TL of the wall constructed with studs spaced at 400 mm (16") o.c. are greater.
- Exterior walls framed with 38 mm x 140 mm (2" x 6") studs are generally constructed with OSB[3] boards or asphalt impregnated wood fibre boards. The wall constructed with asphalt impregnated wood fibre boards instead of OSB boards provided a significantly better sound transmission loss for all frequencies above

1 (STC= Sound Transmission Class)
2 (OITC= Outside Inside Transmission Class)
3 (OSB= Oriented Strand Board)

CMHC SCHL

HOME TO CANADIANS
Canada

125 Hz, even though the surface mass of the wood fibre boards is more than two times less than that of the OSB boards. Below 125 Hz the OSB boards provide a slightly superior sound insulation. The difference of only 0 to 2 points between the STC and OITC ratings measured on walls constructed with asphalt impregnated wood fibre board and those measured on walls constructed with OSB boards can be misleading since it suggests that the walls provide similar acoustical performance when in fact, the transmission loss curves indicate that the wall constructed with the wood fibre board is clearly superior to that constructed with OSB boards. The effect of the 3 mm (1/8") airgap that the manufacturer recommends to leave between the OSB boards tested has not been fully investigated during this study and should be investigated further in a subsequent study.

- When using 38 mm x 89 mm (2" x 4") studs, the most popular materials used to reach the RSI 3.5 (R_{20}) insulation factor and to provide suitable air barrier are either 38 mm (1 ½") thick semi-rigid fibrous insulation covered with a housewrap air barrier or 38 mm (1 ½") extruded polystyrene insulation. The results of the present study suggest that walls constructed with a fibrous insulation covered with a housewrap air barrier provides a sound insulation performance significantly superior to that of walls built with a polystyrene insulation. The STC and OITC ratings measured were 2 to 3 points in favour of the fibrous material.

- In the case of the four types of exterior wall tested in this research, adding a PVC cladding had little or no effect on the transmission loss at low frequency (below 125 Hz). Since the OITC rating is governed mainly by the low frequency sound transmission loss, a variation of only 2 points was noted between the OITC ratings of the walls tested. The increase of STC rating caused by the addition of a PVC cladding is in the order of 1 to 4 points and is mainly governed by the sound transmission loss measured between 125 and 400 Hz. The PVC cladding provided the greatest sound transmission loss increase when it was installed on wall n° 8 constructed with 38 mm x 89 mm (2" x 4") studs and a semi-rigid 38 mm (1 ½") thick fibrous insulation covered with a housewrap air barrier. It was not in the scope of this research project to test several exterior finishes currently used in the Canadian residential construction industry.

- Comparing the results of the sound transmission loss measurements made on the four exterior walls studied in the present research project (walls n° 6 to 9), it is noticed that:

  - Although there is a variation of only 1 point in the OITC and 3 points in the STC ratings of the four walls tested with exterior finishes, it cannot be concluded that they provide equivalent sound insulation for exterior noise sources having different spectra. In fact, the difference between the sound transmission loss provided at frequencies above 125 Hz by the four walls tested in this study can reach 10 dB.

  - Below 125 Hz, the walls tested provided an equivalent sound insulation. All the walls provided their minimum sound transmission loss at 80 Hz; the transmission loss at that frequency was approximately 12 dB.

  - From 125 to 315 Hz wall no 6 constructed with 38 mm x 140 mm (2" x 6") studs and asphalt impregnated wood fibre board provided the best sound insulation, followed by wall n° 8 constructed with 38 mm x 89 mm (2" x 4") studs and semi-rigid glass fibre insulation.

  - From 315 Hz and above wall n° 8 provided the best sound insulation followed by wall n° 6.

  - When expressed in terms of STC rating the walls constructed with 38 mm x 89 mm (2" x 4") studs provided a slightly better sound

insulation than those constructed with 38 mm x 140 mm (2" x 6") studs. The walls constructed with a PVC cladding ranked as follows starting from that providing the highest sound isolation:

Wall	STC	
n° 8:	41	38 mm x 89 mm (2" x 4") with semi-rigid fibre insulation
n° 6:	40	38 mm x 140 mm (2" x 6") with asphalt impregnated wood fibre board
n° 9:	39	38 mm x 89 mm (2" x 4") with rigid polystyrene insulation
n° 7:	38	38 mm x 140 mm (2" x 6") with OSB boards

- An evaluation based on noise spectra collected during a recent noise climate survey made by MJM Acoustical Consultants Inc. and the results of the present study suggests that walls n° 6 to 9 should provide enough sound insulation to reduce exterior noise due to road and rail traffic from a $Leq^{4}_{(24H)}$ = 60 dB(A) outside to a $Leq_{(24H)}$ = 35 dB(A)[5] inside a home. However, wall compositions n° 6 to 9 should not be used in residential sites where the exterior noise due to vehicular or train traffic levels exceeds a $Leq_{(24H)}$ of 60 dB(A).
- It is now relatively frequent in low cost developments incorporating "new house concepts" to build detached homes separated by a distance of only 4 to 5 feet. With the low frequency output of the contemporary home sound systems, it is probable that the low frequency content of music or films could be transmitted from home to home via exterior walls n° 6 to 9 in residential projects where homes are separated by only a few feet.

Contribution to the Construction Industry

This research provided reliable sound transmission loss data on exterior walls with wood structure destined to low cost housing. Further research will be required to confirm some of its findings and to determine ways of improving the acoustical performance of exterior walls of buildings to be constructed in noisy environments.

4 $Leq_{(duration)}$: Equivalent sound pressure level integrated over the sampling period or duration indicated between parenthesis. This quantity is useful to compare fluctuating noises; it corresponds to the sound pressure level of a steady state noise whose acoustical energy and duration are the same as the fluctuating noise measured.

5 Note: $Leq_{(24H)}$ = 35 dB(A) is the CMHC noise level criteria for exterior noise transmission due to vehicular and train noise not to be exceeded inside bedrooms of residential projects.

CMHC Project Manager: Ken Ruest

Research Report: *Research Project On The Noise Insulation Provided By Exterior Walls In Wood Construction*

Research Consultant: Michel Morin, MJM Acoustical Consultants Inc., Montreal

A full report on this project is available from the Canadian Housing Information Centre at the address below.

Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

This **Research Highlights** fact sheet is one of a wide variety of housing-related publications produced by CMHC.

For a complete list of **Research Highlights**, or for more information on CMHC housing research and information, please contact:

The Canadian Housing Information Centre
Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, ON K1A 0P7

Telephone: 1 800 668-2642
FAX: 1 800 245-9274

OUR WEB SITE ADDRESS: www.cmhc-schl.gc.ca

60975